

08/16/00
JC613 U.S. PTO

8-17-00

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BOX PATENT APPLICATION
Commissioner for Patents
Washington, DC 20231

Attorney's Ref:
Date: August 16, 2000

Sir:

Transmitted herewith for filing is the (X) utility () design patent application of
Inventor(s): Alex S. Toback
For: Self-Drilling, Self-Anchoring Fastener for Concrete

JC613 U.S. PTO
09/639599
08/16/00

Enclosed are:

- (X) 9 sheets of (X) formal () informal drawings.
- () An assignment of the invention to _____.
- () A certified copy of a _____ application.
- () An associate power of attorney.
- (X) A verified statement claiming small entity status.
- (X) A declaration (Signed)
- () A preliminary amendment.

The filing fee has been calculated as shown below:

- () design application for () small entity = \$165 () not small entity = \$330
- (X) utility application

	<u>No. Filed</u>	<u>No. extra</u>	<u>Small Entity</u> <u>Rate</u>	<u>Fee</u>		<u>Not Small Entity</u> <u>Rate</u>	<u>Fee</u>
Basic Fee				\$345	OR		\$690
Total Claims	18 - 20 =	x 9 =			OR x	18 =	
Indep. Claims	3 - 3 =	x 39 =			OR x	78 =	
Multiple Dependent Claims Presented		+ 130 =			OR +	260 =	
		TOTAL =	\$ 345			TOTAL =	

- (XX) A check in the amount of \$ 345 to cover the Filing Fee is enclosed.
- () Please charge my Deposit Account No. 16-2563 in the amount of \$ _____ to cover the filing fee. A duplicate of this sheet is enclosed.
- (XX) The Commissioner is hereby authorized to charge any additionally required filing fees under 37 CFR 1.16 associated with this communication or credit any overpayment to Deposit Account No. 16-2563. A duplicate copy of this sheet is enclosed.
- () The Commissioner is hereby authorized to charge fees under 37 CFR 1.16 and 1.17 required during the pendency of this application and to credit any overpayment to Deposit Account No. 16-2563. A duplicate copy of this sheet is enclosed.

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I, Talisha L. Cooper, hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" Service under 37 CFR 1.10 on August 16, 2000 and is addressed to the Assistant Commissioner for Patents, Washington, DC 20231.

Talisha L. Cooper

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CONNECTION SYSTEM FOR STEEL CONSTRUCTION

Cross-Reference to Related Application

This application claims the priority of U.S. Provisional Application Serial No. 60/149, 414, filed on August 17, 1999

Background of the Invention

This invention relates generally to connectors and connection systems for light gauge steel construction and the like. More particularly, this invention relates to methods and fastening systems employed for connecting light gauge steel employed in the construction trades for housing and structures and the like.

In conventional systems to which the invention relates, load distribution codes in light steel connections are entirely satisfied by the use of screws. In such conventional systems, numerous screws or fasteners are required to provide the connection, and self-drilling screws are preferred.

Brief Summary of the Invention

The present invention takes a novel approach by providing a light gauge steel connection having an enhanced load bearing capacity through the use of both fasteners and a structural adhesive. By using a structural adhesive, the number of required fasteners is significantly decreased while the load bearing capacity and durability of the connection is increased.

The application can be employed with numerous mechanical fasteners such as self-drilling screws, pins, rivets and clinches. The adhesive is preferably a two-part epoxy adhesive system with a one to one metered mix formulation which cures at room temperature and has a very high viscosity.

Brief Description of the Drawings

Figure 1(a) is a schematic representational view of a prior art fastening system connecting a steel stiffening strap in a shear wall application with gusset plates;

Figure 1(b) is a schematic representational view illustrating, by contrast with Figure 1(a), the connection system of the present invention;

Figure 1(c) is a fragmentary sectional view of the connection system of 1(b) taken along the line c-c thereof;

Figure 2 is a schematic representational diagram illustrating a prior art connection system for 20 gauge steel strips which are connected with a four square inch overlap by screw fasteners in accordance with the prior art connection system;

Figure 3 is a schematic representational diagram for 20 gauge steel strips with a four square inch overlap which are connected by screw fasteners and adhesive in accordance with the connection system of the present invention;

Figure 4 is a hysteresis graph illustrating a push/pull deflection test for a single sided 18 gauge steel diaphragm wall employing No. 14 screws for fastening;

Figure 5 is a hysteresis graph illustrating a push/pull deflection test for an 18-gauge steel diaphragm wall employing No. 14 screws and an adhesive bonding system for fastening in accordance with the present invention;

Figure 6 is a hysteresis graph illustrating a push/pull deflection test for a single sided 22 gauge steel diaphragm wall employing No.14 screws for fastening the panel;

Figure 7 is a hysteresis graph illustrating a push/pull deflection test for a single sided 22 gauge steel diaphragm wall employing No. 14 screws and an adhesive bonding system for fastening in accordance with the present invention;

Figure 8 is a schematic representational diagram illustrating one embodiment of the invention;

Figure 9 is a schematic representational diagram illustrating a prior art connection system for 20 gauge steel strips which are connected with a four square inch overlap by pin fasteners in accordance with the prior art connection system; and

Figure 10 is a schematic representational diagram for 20 gauge steel strips with a four square inch overlap which are connected by pin fasteners and adhesive in accordance with the connection system of the present invention;

Detailed Description of the Preferred Embodiments

The invention is schematically illustrated by Figures 1(a) and 1(b) which contrast the conventional design (Figure 1(a)) with the adhesive/fastener design of the present invention (Figure 1(b)). With reference to Figure 1(a), a conventional stiffening strap 12 is illustrated in a shear wall application with gusset plates 14. Numerous fasteners 20 are required.

By contrast, the present invention, which employs both an adhesive 10 and fasteners 20, dramatically reduces the number of required fasteners (schematically illustrated) while enhancing the load bearing capacity and integrity of the connection.

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The adhesive 10 which is employed in the system is selected so as to have a high shear and peel strength, room temperature curing and easy application characteristics at room temperature. The adhesive is also tough, does not fail adhesively under loads and is capable of adhering to as-received galvanized steel. The adhesive 10 may be applied to the metal panel 30 and/or the support structure 40, such as a stud, by a hand operated or automatic dispensing device 16.

In one embodiment of the invention, the adhesive 10 fully cured at room temperature within 72 hours. One acceptable adhesive employed in the invention is an adhesive sold as Formulation No. 12059A marketed by the Advanced Adhesive Systems, Inc., of Newington, Connecticut. The adhesive is a two part epoxy system having a substantially 1:1 resin/hardener mix by weight or volume which has a very high viscosity and cures at room temperature. This formulation upon curing has a Shore D of 40-45 and an operating temperature range of -40° F to 250° F. The adhesive 10 may also be another room temperature or heat activated adhesion system such as a methacrylate, urethane, etc.

With reference to Figure 8, in accordance with one embodiment of the invention, the adhesive is applied to one or both of the steel surfaces to form beads 32 and/or 42. The other panel 30 is placed in an overlapping relationship against the stud 40. Self-drilling fasteners 20 are then inserted through the panels by power driver 24 and the adhesive is compressed between the panel 30 and the stud 40. The fasteners 20 are preferably Metaltite self-drilling metal panel fasteners (disclosed in U.S. Patent No. 5,304,023 assigned to Metaltite Corporation of West Hartford, Connecticut) because of their high resistance to pull-out. The adhesive is then allowed to cure.

The integrity of the adhesive/fastener connection system was demonstrated by lap-joint shear tests conducted on 20 gauge, as received, steel strips 50 and 52 which were connected with a four square inch overlap. Figure 2 illustrates the integrity of the connection for various configurations wherein screws 20 only were employed. These connections were tested in shear with the corresponding quantities at the bottom illustrating the failure point of the connection in pounds. A side view illustrating the lap-joint and schematically representing the shear loading is at the extreme right of Figure 2. When an adhesive 10 was also applied, the tests were repeated, and the results are illustrated in Figure 3. A side view illustrating the lap joint and schematically representing the shear loading is at the extreme right of Figure 3. It will be appreciated that the joint integrity was significantly enhanced.

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Figures 4-7 illustrate the effect of push-pull cyclic loading on 4' X 8' light gauge steel panels assembled to steel studs with only fasteners and with an adhesive/fastener combination. The resulting assembly is referred to as a "single sided diaphragm wall."

The push-pull cyclic load is applied to the top of the wall at 5 seconds per cycle. The resulting top-of-the-wall deflection is measured and plotted against the push-pull load. The resulting graphs show top-of-the-wall deflection lagging the applied load. The retardation of the effect when the forces acting upon a body are changed is defined as hysteresis. Push-pull tests were conducted under substantially equivalent conditions for the results of Figures 4-7. These hysteresis graphics demonstrate favorable test results for the adhesive/fastener connection system in accordance with the present invention. In comparison to connection systems which employ screws without adhesive, the results show superior adhesive and connection characteristics per fastener.

Figure 4 is a hysteresis graph of a single sided 18-gauge steel diaphragm wall assembled with No.14 self-drilling panel screws. The vertical axis is the applied load on top of the wall. The units are thousand pounds per square inch. The horizontal axis represents the top-of-the-wall deflection in inches.

Figure 5 shows the same 18-gauge steel diaphragm wall wherein No 1 self-drilling panel screws were fastened to connect the panels to the frame, and in addition, a prototype adhesive was applied at the perimeter and the center of the studs.

Figure 6 shows a hysteresis graph for a single sided 22 gauge steel panel wherein No. 14 self-drilling panel screws fasten the panel to the frame.

Figure 7 shows a hysteresis graph for the panel of Figure 6 where, in addition, a prototype adhesive at the perimeter and the center of the studs was applied.

It should be appreciated that the hysteresis graphs clearly demonstrate that there is a superior connection by usage of the adhesive and the self-drilling screws.

The invention may also be employed with other mechanical fasteners such as screws of various types, pins, rivets and clinches. The invention may also be used with types of numerous support structures such as steel and metal studs, non-metallic studs, framing, FRP plastics panel and plywood panel, etc.

With reference to Figures 9 and 10, the integrity of the adhesive/fastener connection system was demonstrated for pins by lap-joint shear test conducted on 20 gauge, as received, steel strips 50 and 52, which were connected with a four inch square overlap in a manner similar to that described for Figures 2 and 3.

Figure 9 illustrates the integrity of the connection for configurations wherein pins 22 only were employed. The pins 22 had a diameter of 0.100 inch and were driven by a pneumatic driver. These connections were then tested in shear with corresponding quantities at the bottom of the figure illustrating the failure point of the connection in pounds. When the adhesive 10, which was a two-part epoxy system, was also applied, the tests were repeated, and the results are illustrated in Figure 10, wherein the failure point in pounds is indicated at the bottom. It should be appreciated that the joint integrity was significantly enhanced when both the adhesive and pins were employed as contrasted with the pins only.

While the foregoing description sets forth a preferred embodiment of the invention, the foregoing description should not be deemed a limitation of the invention herein. Other adaptations, modifications and alternatives may occur to one skilled in the art without departing from the spirit and scope of the present invention.

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What is claimed is:

1. A connection system for connecting at least one light gauge steel panel to a support structure comprising:

applying an adhesive to at least one of said panel or support structure, said adhesive being curable at room temperature and able to adhere to steel;

placing said panel against said support structure;

driving at least one fastener through the panel into said support structure; and

allowing said adhesive to cure,

so that said panel is joined to said structure in a connection which is superior in load bearing capacity to a connection provided by the fastener alone.

2. The connection system of Claim 1 wherein the fastener is selected from the group consisting of self-drilling screws, rivets, pins, and clinches.

3. The connection system of Claim 1 wherein each said fastener is a self-drilling screw.

4. The connection system of Claim 1 wherein said adhesive is a two-part epoxy system.

5. The connection system of Claim 4 wherein said epoxy system comprises a resin and hardener which are mixed in substantially equal portions by weight.

6. The epoxy system of Claim 4 wherein said epoxy system comprises a resin and hardener which are mixed in substantially equal portions by volume.

7. The connection system of Claim 1 wherein said adhesive fully cures within approximately 72 hours.

8. A connection system for connecting at least one light gauge steel member to a second member comprising:

applying bead of epoxy to at least one of said members, said epoxy being curable at room temperature and able to adhere to steel;

positioning said members in adjacent relationship with said epoxy disposed between said members;

driving at least one fastener through one member into said other member; and

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allowing said epoxy to cure,
so that said members are joined in a connection which is superior in load bearing capacity to a connection provided by the fastener alone.

9. The connection system of Claim 8 wherein the fastener is selected from the group consisting of self-drilling screws, rivets, pins, and clinches.

10. The connection system of Claim 8 wherein each said fastener is a self-drilling screw.

11. The connection system of Claim 8 wherein said epoxy comprises a resin and hardener which are mixed in substantially equal portions by weight.

12. The epoxy system of Claim 8 wherein said epoxy comprises a resin and hardener which are mixed in substantially equal portions by volume.

13. The connection system of Claim 8 wherein said adhesive fully cures within approximately 72 hours.

14. The connection system of Claim 8 wherein a bead of epoxy is applied to both members.

15. The connection system of Claim 1 wherein said adhesive is composed of a material selected from the group consisting of epoxy, methacrylate and urethane.

16. A connection system for connecting at least one light gauge steel panel to a steel frame comprising:

applying bead of adhesive to at least one of said panel or frame, said adhesive being curable at room temperature and able to adhere to steel;

positioning said panel against said frame with said adhesive disposed between said panel and frame

driving at least one fastener through said panel into said frame and;

allowing said adhesive to cure,

so that said panel is joined to said frame in a connection which is superior in load bearing capacity to a connection provided by the fastener alone.

17. The connection system of Claim 16 wherein the fastener selected from the group consisting of self-drilling screws, rivets, pins, and clinches.

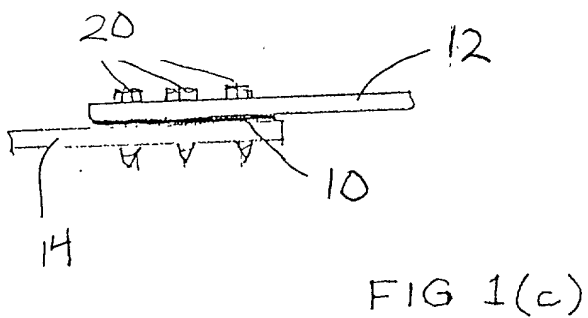
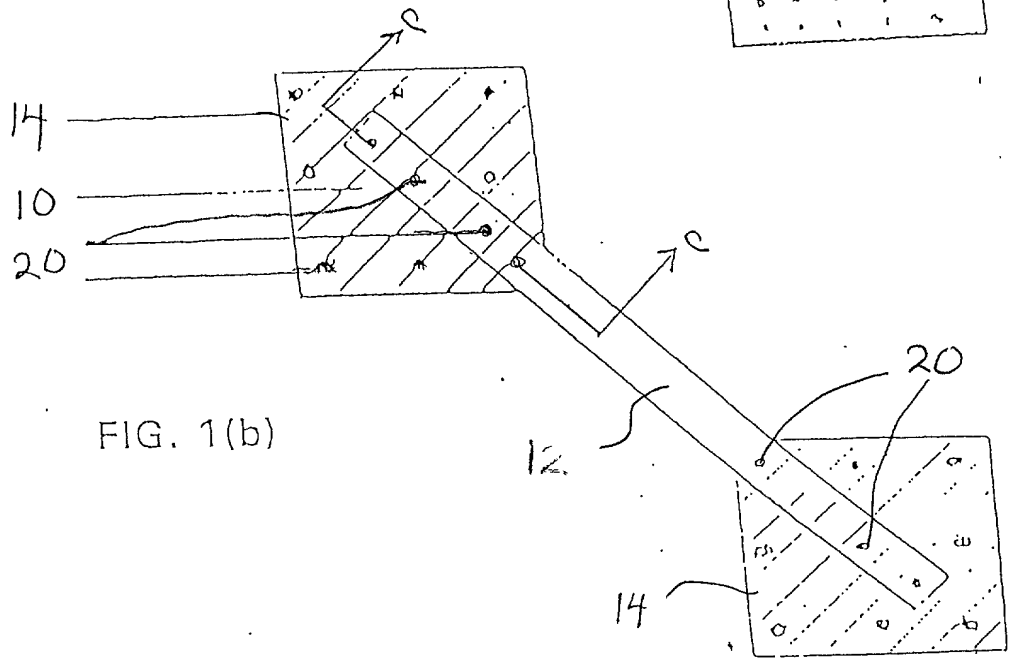
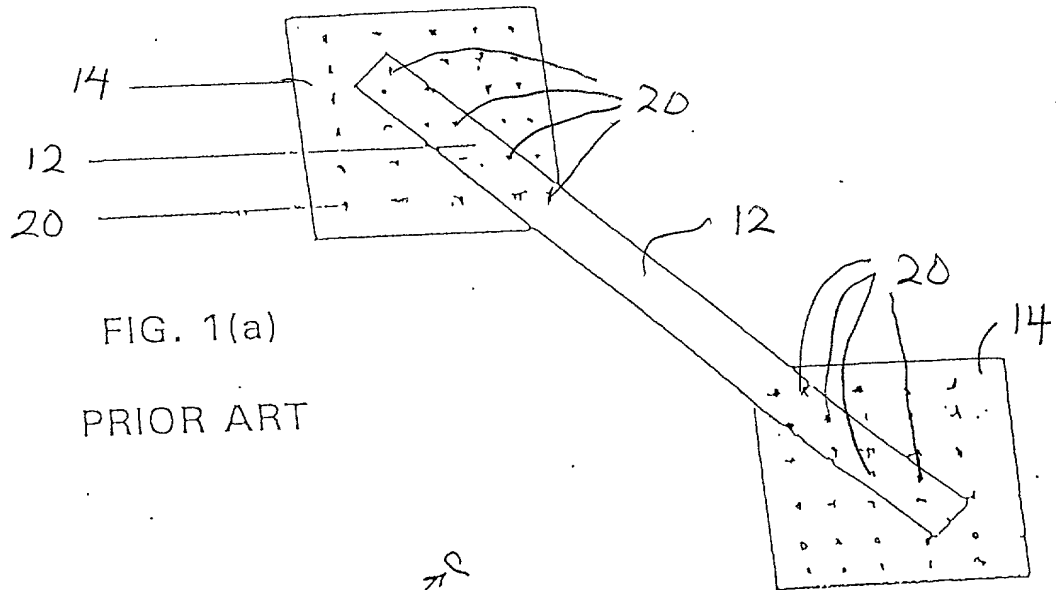
18. The connection system of Claim 16 wherein the adhesive is selected from the group consisting of epoxy, methacrylate, and urethane.

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ABSTRACT OF THE DISCLOSURE

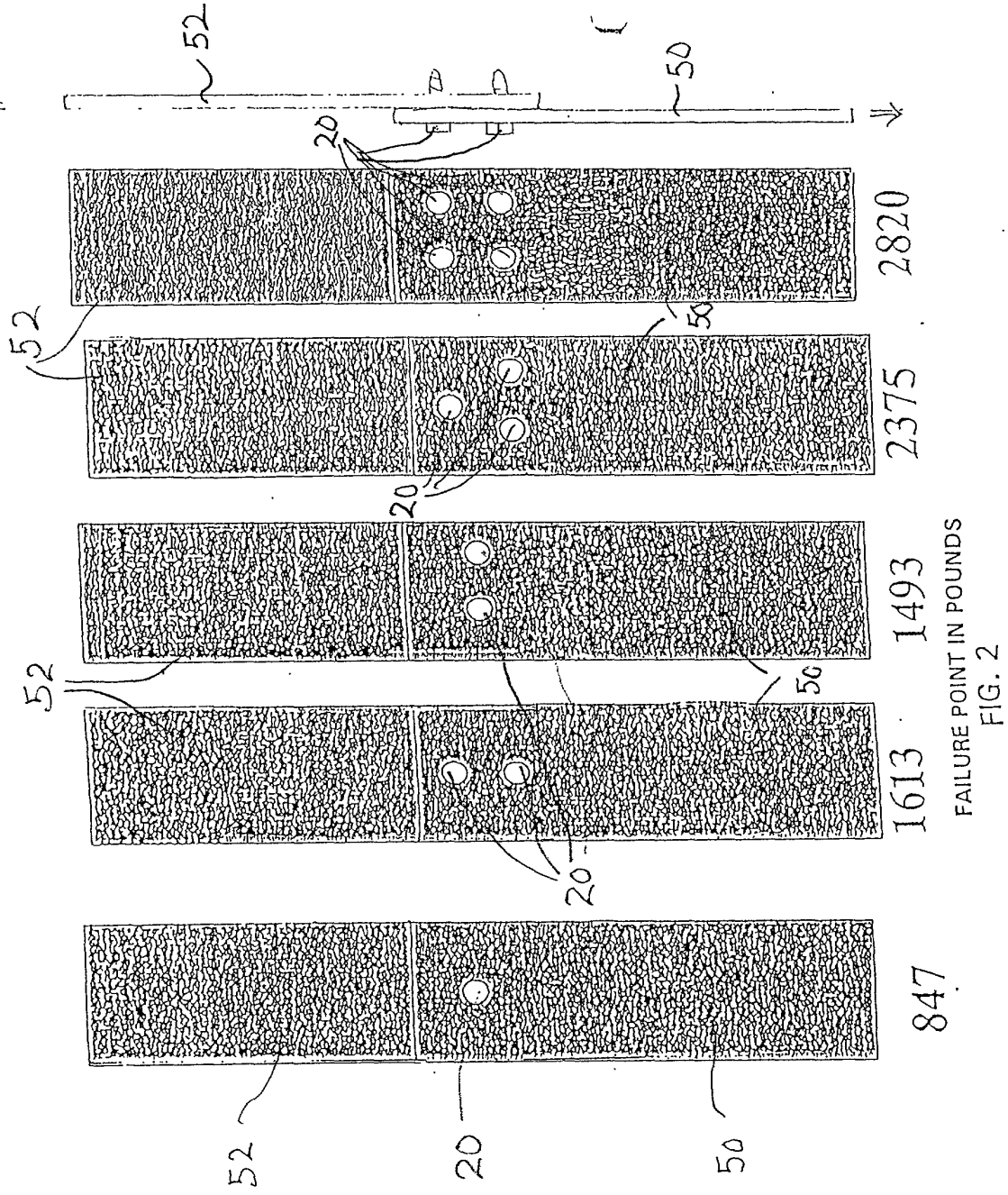
A connection system for steel construction employs both fasteners and an adhesive for connecting steel panel to a stud, frame, FRP plastics panel or plywood panel. The fasteners may be a self-drilling screw, rivets, pins, clinches or other mechanical fasteners. The adhesive is preferably a two-part epoxy system which cures at room temperature.

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 LAP-JOINT SHEAR SPECIMENS
 SCREWS ONLY

20 gauge as-received steel with 4 square inch overlap



FAILURE POINT IN POUNDS
 FIG. 2

LAP-JOINT SHEAR SPECIMENS

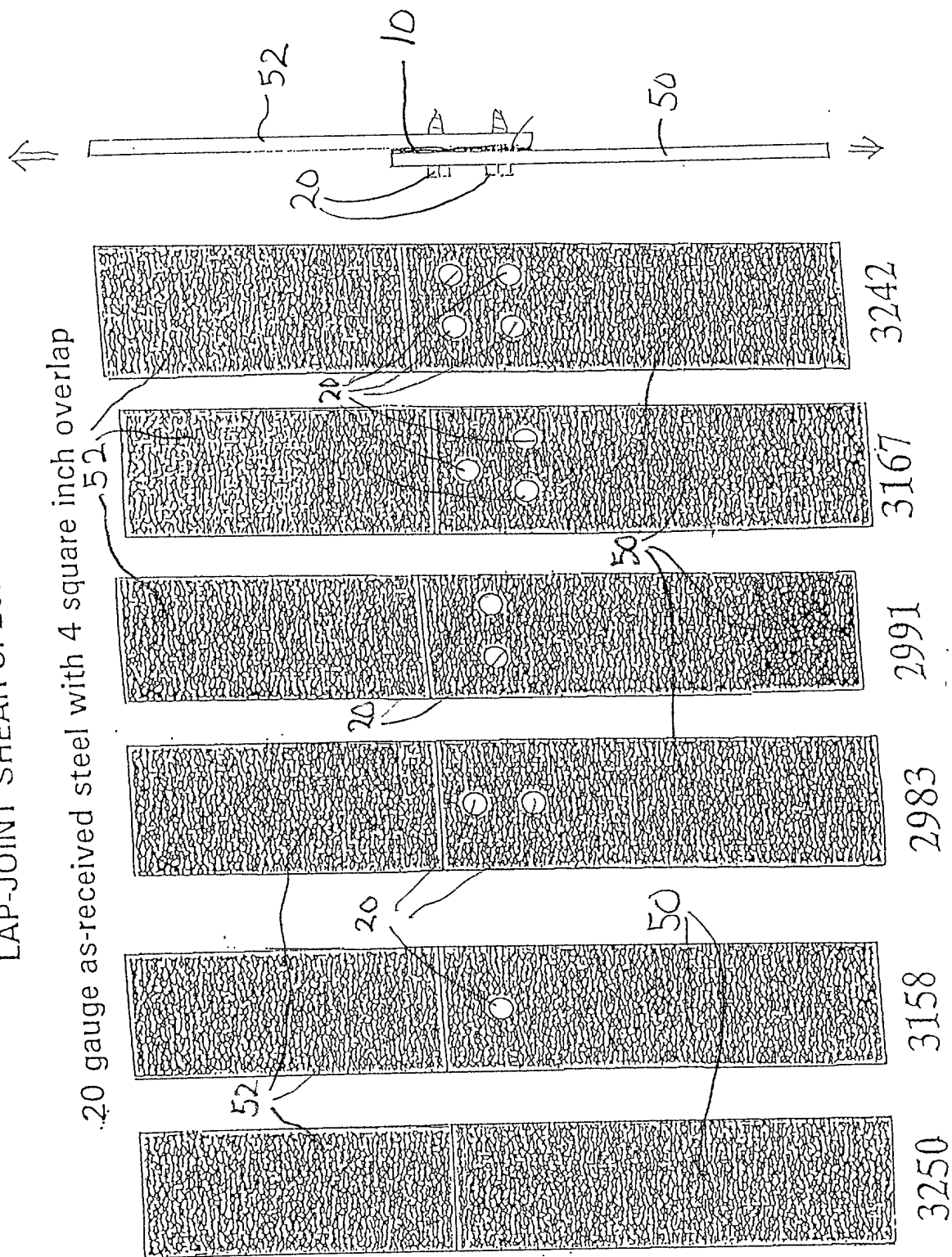
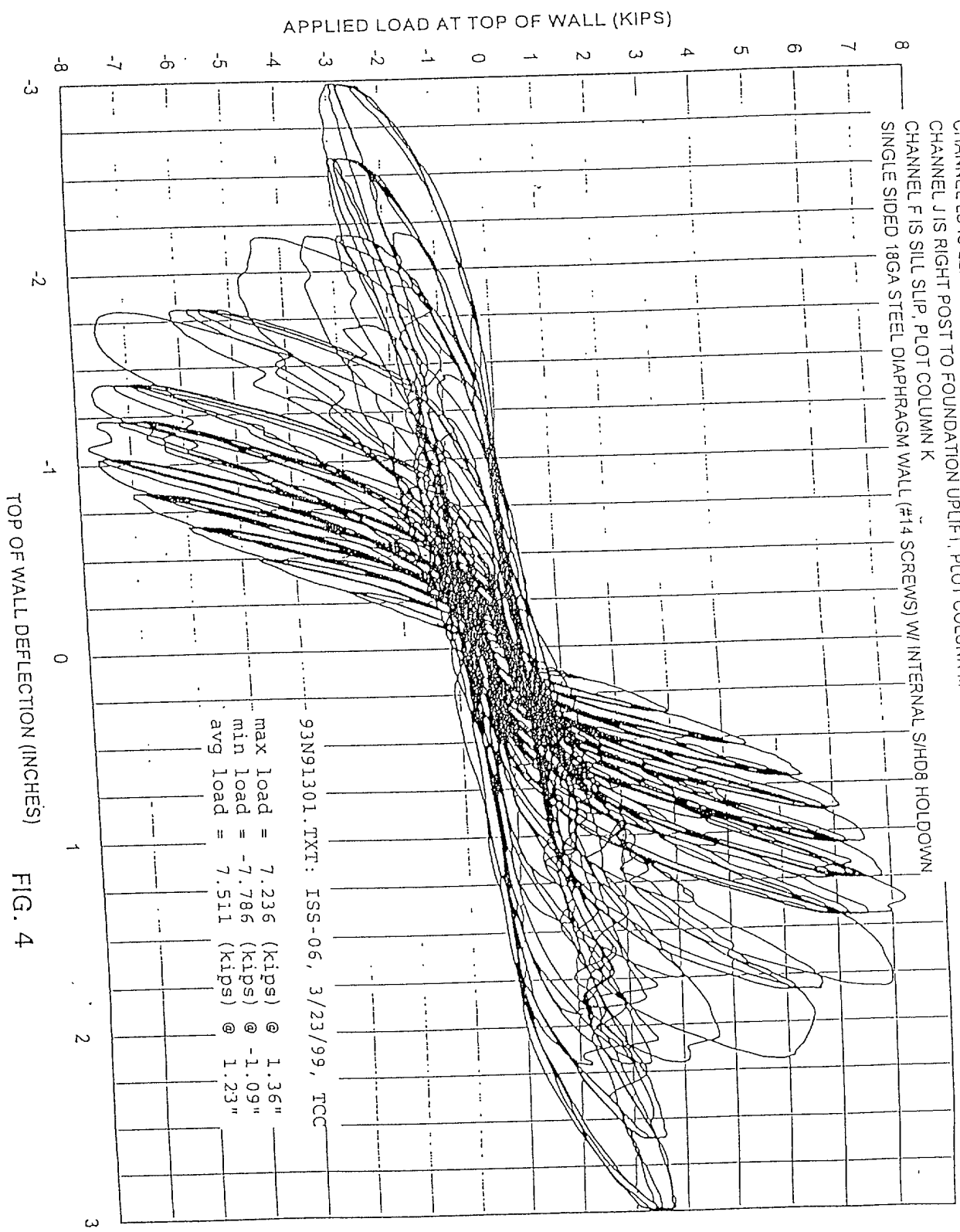


FIG: 3

ISS-06, 3/23/99, TCCMAR2 LOADING AT 5 SECONDS PER CYCLE, FME=0.8
 CHANNEL LD IS LEFT POST TO FOUNDATION UPLIFT, PLOT COLUMN H
 CHANNEL J IS RIGHT POST TO FOUNDATION UPLIFT, PLOT COLUMN M
 CHANNEL F IS SILL SLIP, PLOT COLUMN K
 SINGLE SIDED 18GA STEEL DIAPHRAGM WALL (#14 SCREWS) W/ INTERNAL SHD8 HOLDOWN



93N91301.TXT: ISS-06, 3/23/99, TCC
 max load = 7.236 (kips) @ 1.36"
 min load = -7.786 (kips) @ -1.09"
 avg load = 7.511 (kips) @ 1.23"

TOP OF WALL DEFLECTION (INCHES) FIG. 4

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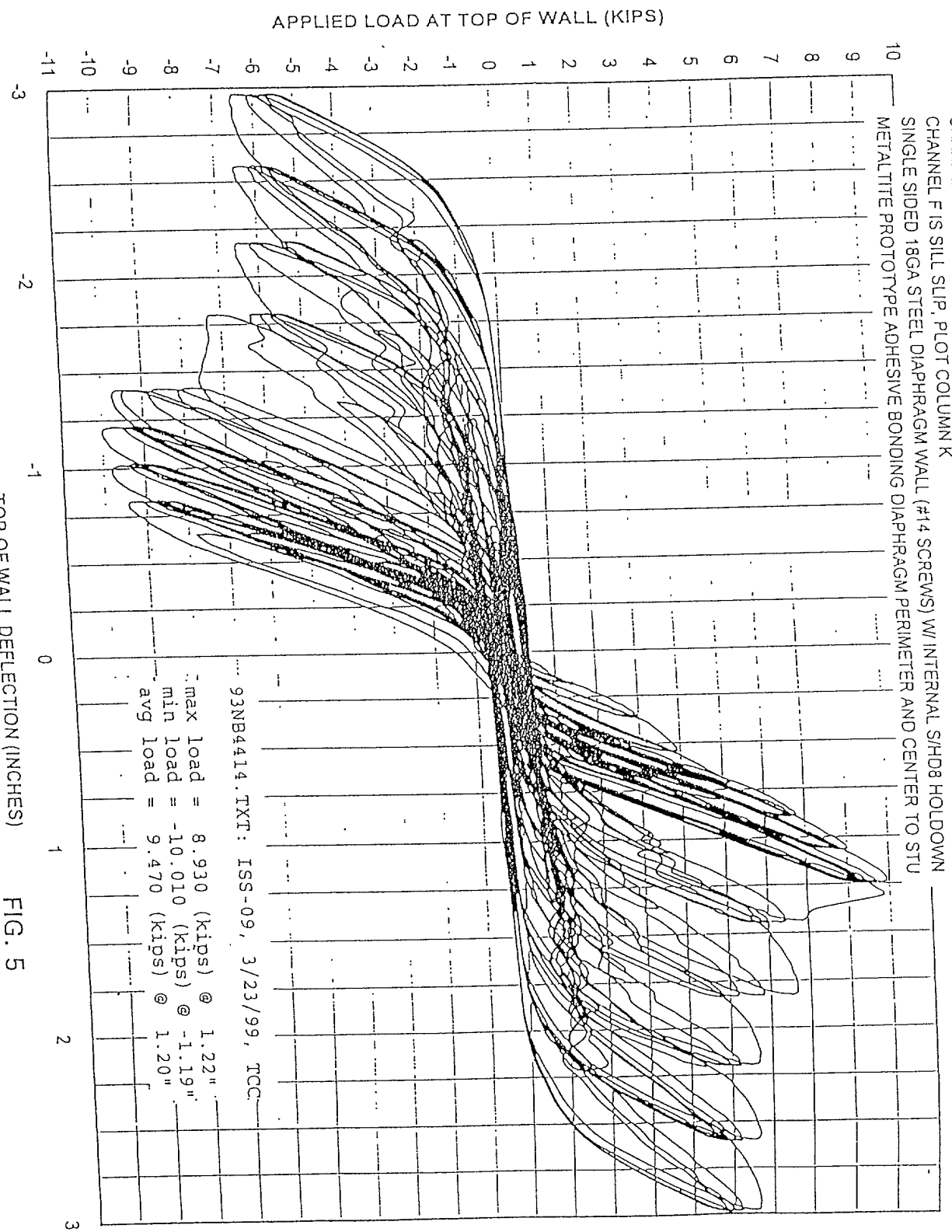


FIG. 5

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ISS-04, 3/22/99, TCCMAR2 LOADING AT 5 SECONDS PER CYCLE, FME=0.8
 CHANNEL LD IS LEFT POST TO FOUNDATION UPLIFT, PLOT COLUMN H
 CHANNEL J IS RIGHT POST TO FOUNDATION UPLIFT, PLOT COLUMN M
 CHANNEL F IS SILL SLIP, PLOT COLUMN K
 SINGLE-SIDED 22GA STEEL DIAPHRAGM WALL (#14 SCREWS) W/ INTERNAL SHD8 HOLDOWN

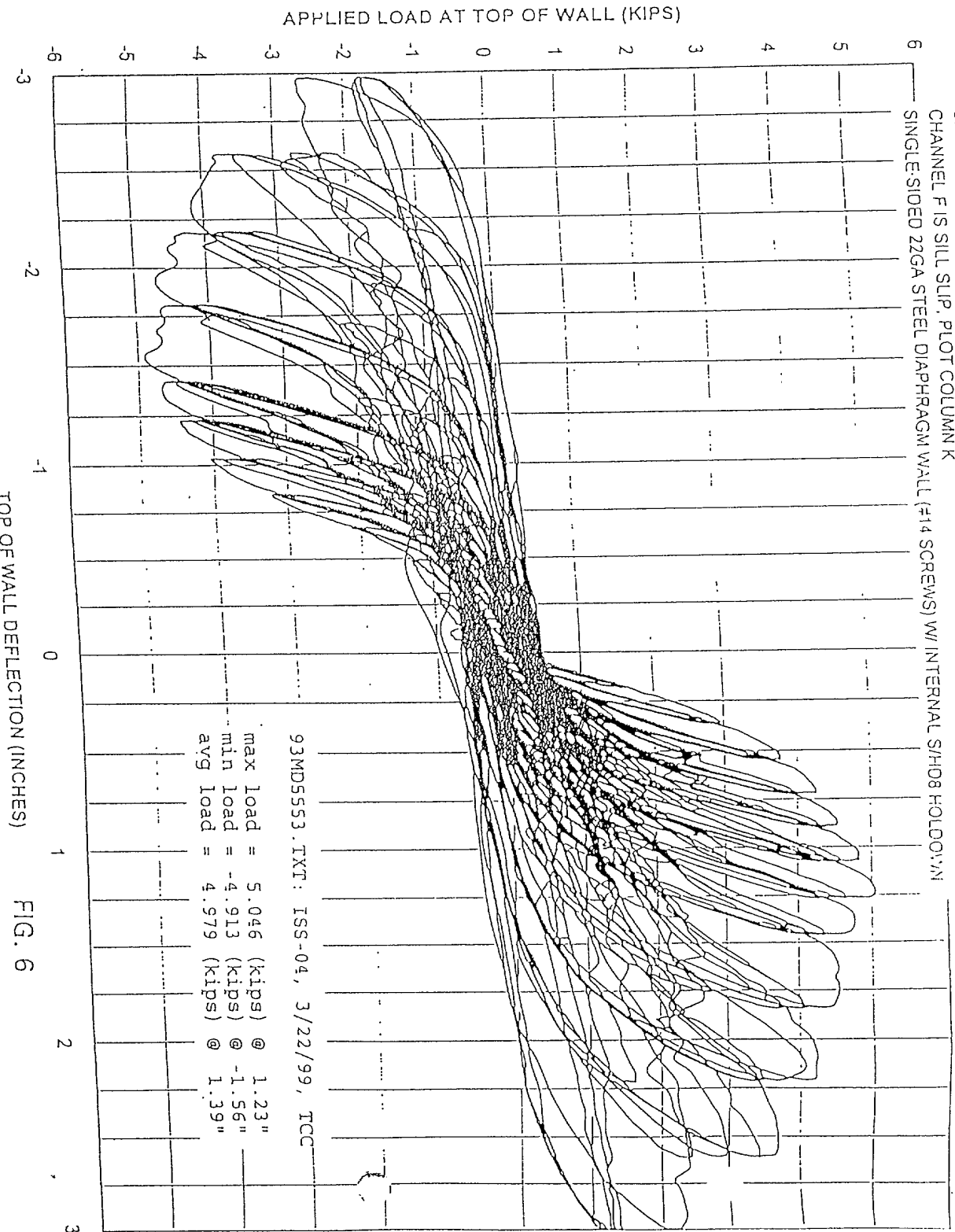


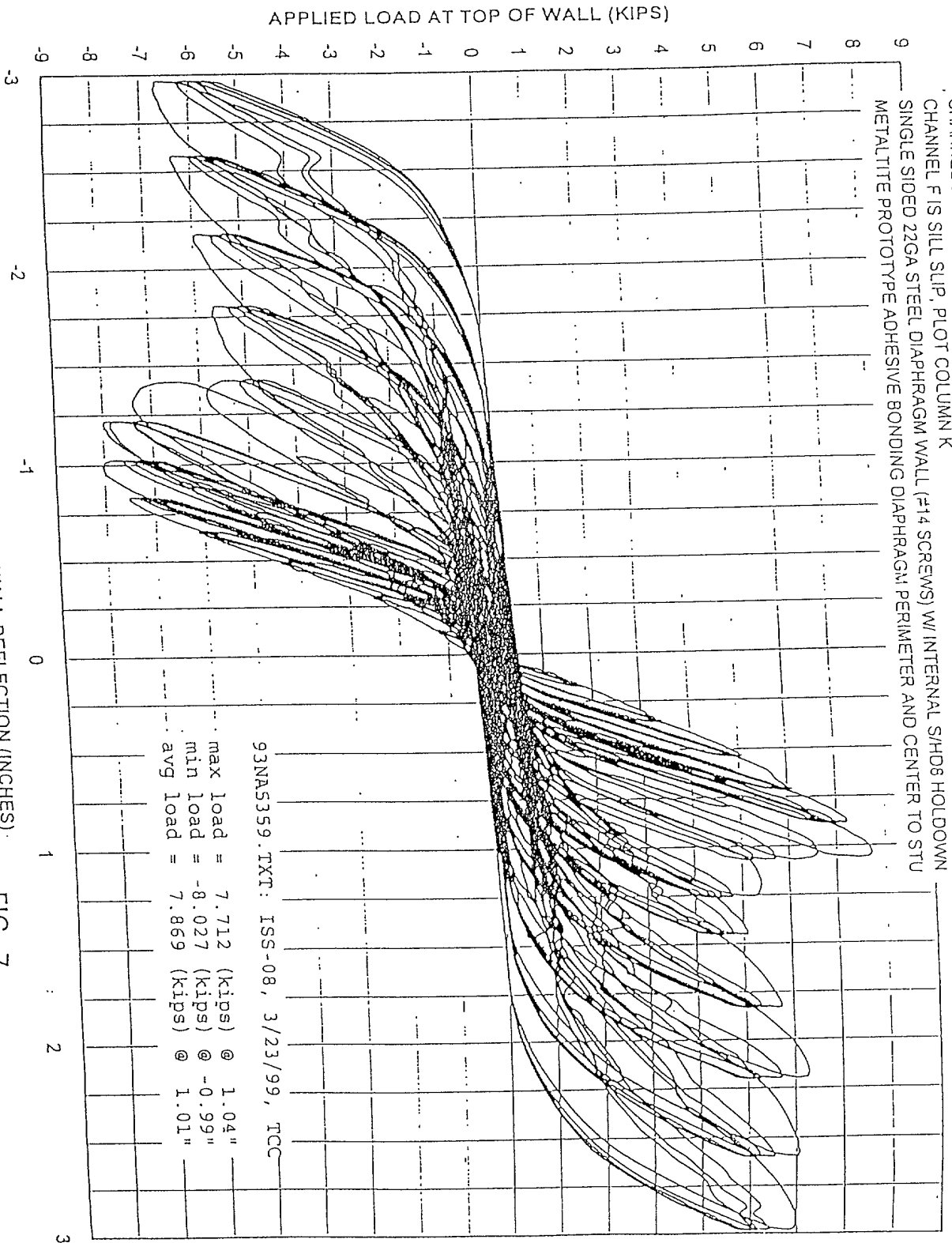
FIG. 6

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TOP OF WALL DEFLECTION (INCHES)

FIG. 7



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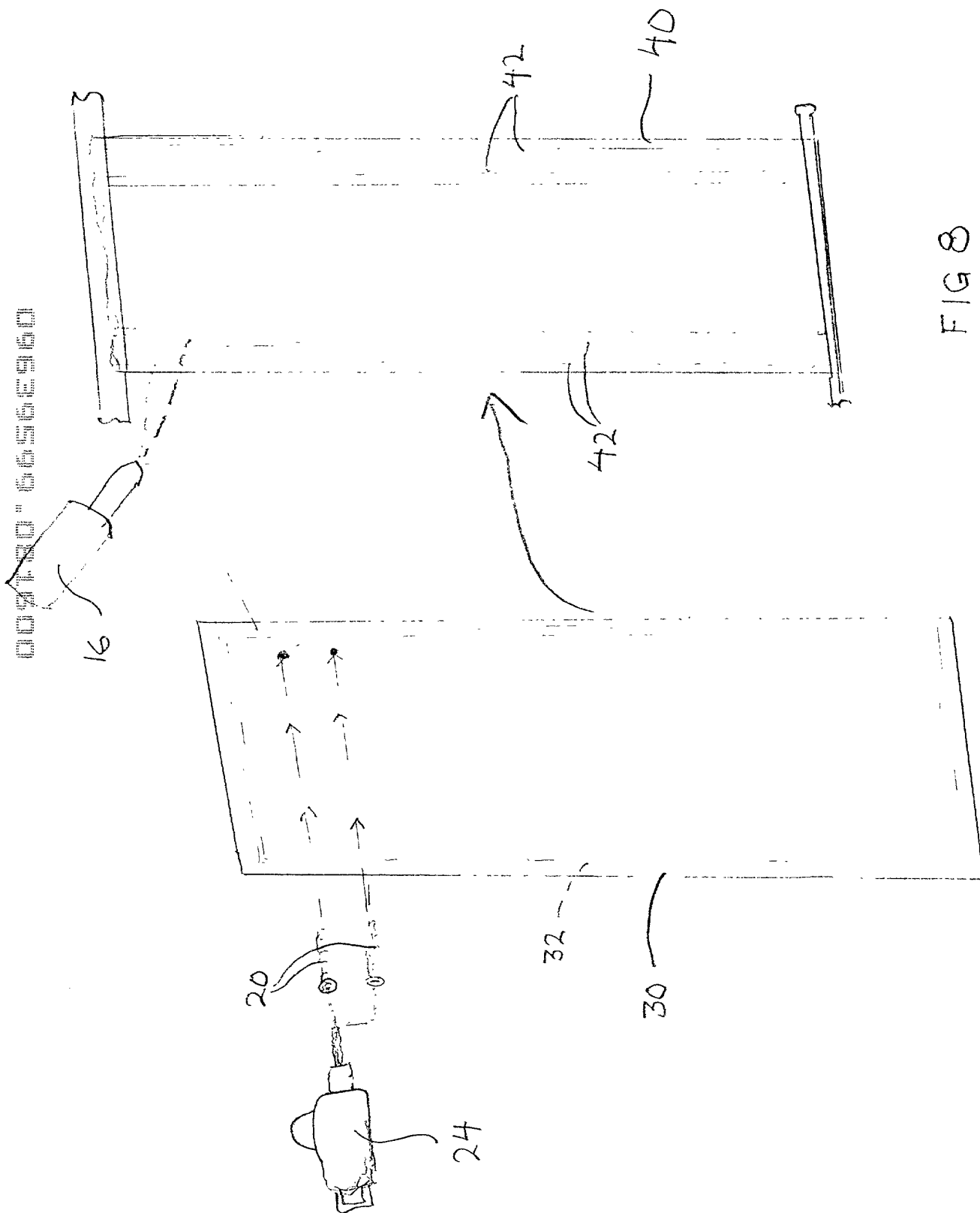


FIG 8

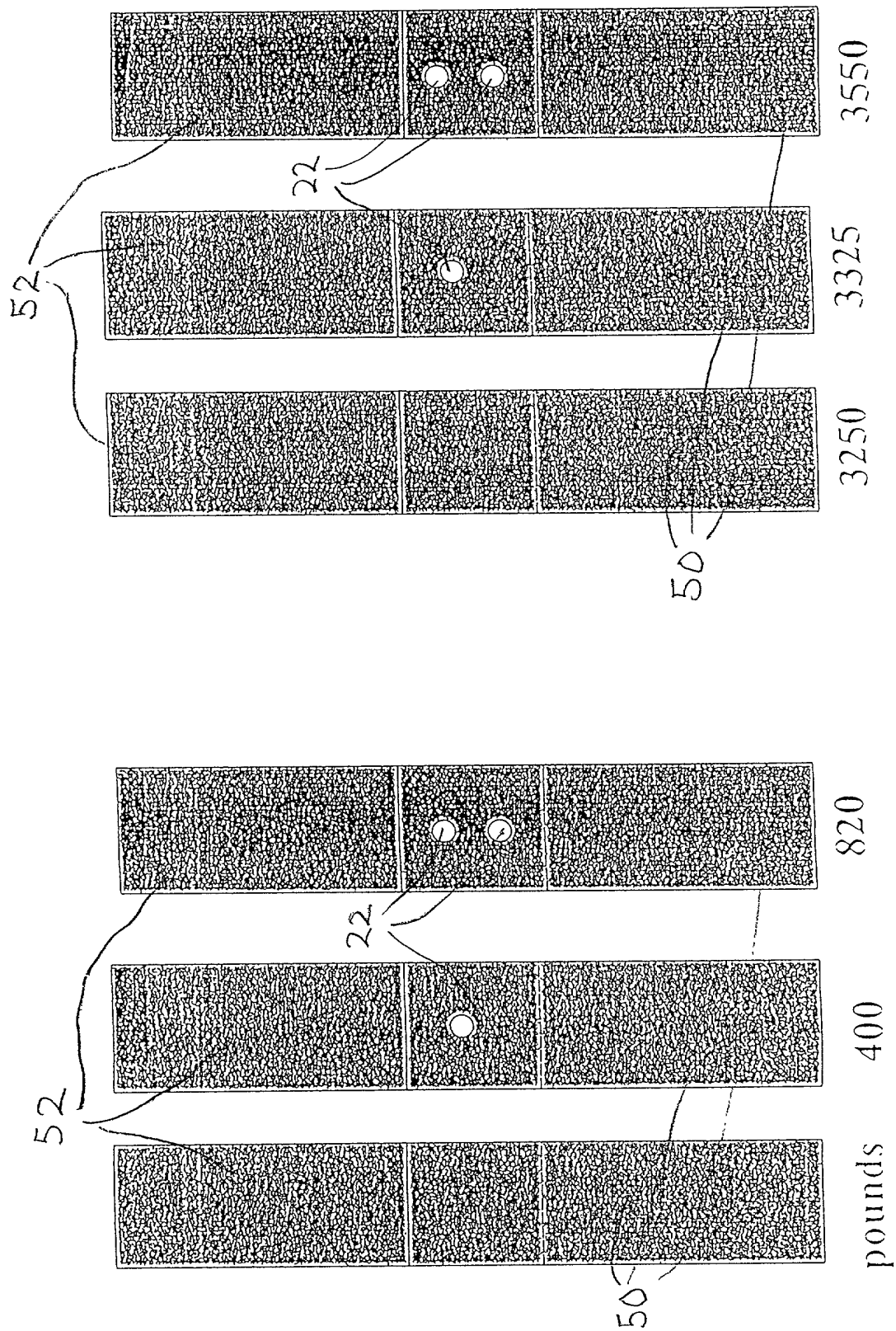
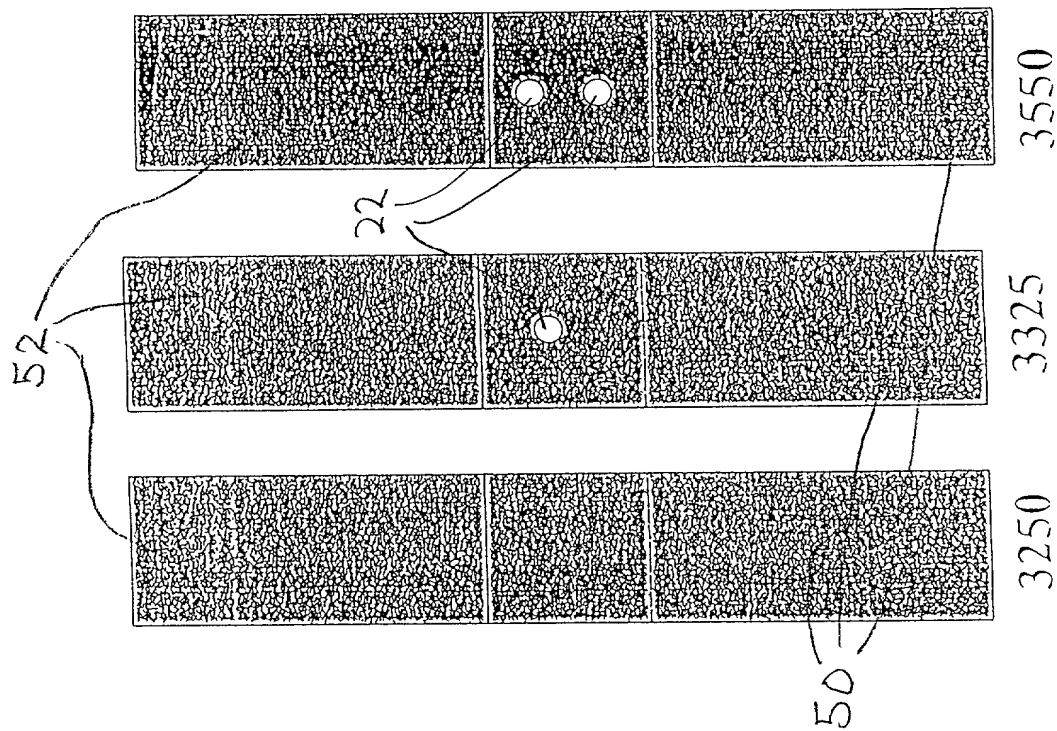


FIG 10



Type a plus sign (+) inside this box → [+]

DECLARATION [] Declaration Submitted with Initial Filing [] Declaration Submitted after Initial Filing	0010/PTO Rev. 6/95	U.S. Department of Commerce Patent and Trademark Office	Attorney Docket	TOB/102/US
			First Named Inventor	Alex S. Toback
			COMPLETE IF KNOWN	
			Application Number	
			Filing Date	
			Group Art Unit	
			Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Connection System for Steel Construction

(Title of the Invention)

the specification of which

[X] is attached hereto

OR

[] was filed on (MM/DD/YYYY) _____ as United States Application or PCT International Application Number _____ and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understood the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37 Codes of Federal Regulations, §1.56.

I hereby claim foreign priority under Title 35, United States Code § 119 (a)-(d) or § 365 (b) of any foreign application(s) for patent or inventor's certificate, or § 365 (a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Numbers	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Copy Attached Yes No
None			[]	[] []
			[]	[] []
			[]	[] []
			[]	[] []
			[]	[] []

[] Additional foreign application numbers are listed on a supplemental priority sheet attached hereto:

I hereby claim the benefit under Title 35, United States Code § 119 (e) of any United States provisional application(s) listed below:

Application Number(s)	Filing Date (MM/DD/YY)	[] Additional provisional application numbers are listed on a supplemental priority sheet attached hereto.
60/149,414	August 17, 1999	

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DECLARATION

Page 2

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s), or §365(c) of any PCT International application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Title Code of Federal Regulations §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

U.S. Parent Application Number	PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)
None			

☐ Additional U.S. or PCT International application numbers are listed on a supplementary priority sheet attached hereto:

As a named inventor, I hereby appoint the registered practitioners associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office therewith, and direct that all correspondence be addressed to that Customer Number:

Firm Name:

Alix, Yale & Ristas, LLP


Customer Number:

002543

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor ☐ A petition has been filed for this unsigned inventor

Given Name	Alex	Middle Initial	S.	Family Name	Toback	Suffix	
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Inventor's Signature		Date	8/16/00
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RESIDENCE: City	West Hartford	State	Connecticut	Country	USA	Citizenship	USA
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POST OFFICE ADDRESS	65 Fox Chase Lane						
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City	West Hartford	State	Connecticut	Zip	06117	Country	USA	Applicant Authority	
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Name of Additional Joint Inventor, if any: ☐ A petition has been filed for this unsigned inventor

Given Name		Middle Initial		Family Name		Suffix	
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Inventor's Signature		Date	
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RESIDENCE: City		State		Country		Citizenship	
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POST OFFICE ADDRESS							
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City		State		Zip		Country		Applicant Authority	
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☐ Additional inventors are being named on supplemental sheet(s) attached hereto.

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Inventor(s): Alex S. Toback
Serial No.:
Filed:
For: Connection System for Steel Construction

**Verified Statement Claiming Small Entity Status
(37 CFR 1.9(f) and 1.27(c)) - Small Business Concern**

I hereby declare that I am

- ☒ the owner of the small business concern identified below:
☐ an official of the small business concern empowered to act
on behalf of the concern identified below:

NAME OF CONCERN: Toback & Associates
ADDRESS OF CONCERN: 106 South Street
West Hartford, Connecticut 06110-1961

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when, either directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in

- ☒ the specification filed herewith.
☐ the application identified above.

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If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights in the invention is listed below; and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e):

NAME: _____
ADDRESS: _____

☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

I acknowledge the duty to file under 37 CFR 1.28(b), in this application or any patent issuing thereon, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: Alex S. Toback
TITLE OF PERSON SIGNING: President
ADDRESS OF PERSON SIGNING: 106 South Street
West Hartford, Connecticut 06110-1961

SIGNATURE  DATE 8/16/00